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INDUSTRIAL APPLICATION OF TAPIOCA (CASSAVA) FOR MANUFACTURING OF TAPIOCA MACARONI OR TAPIOCA RICE

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Industrial application of Tapioca (Cassava) for manufacturing of

Tapioca Macaroni or Tapioca Rice

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a) Remarks of scientific development and justification in relation of the nutrition

The Indian national leaders as also Government authorities are anxious that the country should not only produce more foodgrains but also make better use of various other forms of food materials that are nutritionally valuable but have not yet been adequately utilised. There are also certain high yielding crops, which, if produced on a larger scale and properly utilised can help to cover the present deficiency.

The General Food Technological Research Institute, during its twelve years of existence, has made important contributions both in regard to more efficient utilisation of the present resources and in the introduction of different types of foodstuffs so far untried by the Indian people. It must be appreciated, however, that the popularisation of such foods presents sociological problems that are fundamental and become quite as important as the scientific and technological work leading to the production of such foods.

The development of Tapioca Macaroni by the Central Food Technological Research Institute and a Swiss manufacturer is a significant accomplishment of concerted effort in the production of a clean, wholesome article of food. Both quantitatively and qualitatively it satisfies scientific standards and technological requirements. The widespread public acceptance of the product (by the rather critical consumers) in the populous state of Kerala encourages us to believe that an important battle is being won and that with further efforts, it will be possible to popularise and to extend the production to other parts of the country.

Tapioca is a root crop (Cassava Manihot utilissima) which yields several times as much starchy food per acre as the cereal crops, (e.g. 3 - 4 times) and require more attention. By itself, Tapioca is an incomplete food, and needs to be enriched with body-building proteins. To produce the desired composition, small percentage of specially prepared groundnut flour and wheat semolina (Soji) have been added to Tapioca flour and the mixture scientifically processed so as to yield products which can be cooked and consumed in the same or similar way as foodgrains or standard Macaroni products.

After years of intensive research at the Central Food Technological Research Institute, Mysore and the Swiss Manufacturer's Laboratory, Tapioca Macaroni is now made up of 60 parts of Tapioca flour, 15 parts of specially processed groundnut flour and 25 parts of wheat semolina or soji. The pilot plant for its manufacture at the Central Food Technological Research Institute, Mysore, has a capacity of two tons a day.

The resulting product contains about 10% protein, twice as much as rice, besides the requisite quantities of minerals and vitamins. Tapioca Macaroni, this low-cost and nutritious new staplefood is wholesome and contains no dirt, stone or other foreign matter.

It cooks within five or eight minutes as compared to rice which takes nearly half an hour.

The basic technique of cooking Tapioca Macaroni is as follows: Six cups of water will be used for each cup of Macaroni. The water has to be brought to a vigorous boil, the Tapioca Macaroni afterwards dropped gradually into the vigorously boiling water and stirred, they will be cooked within five or eight minutes. After draining the gruel, the cooked Tapioca Macaroni may be used in the same way as rice or for the preparation of different dishes.

Part extract of the booklet: Tapioca Macaroni goes to people

b) The Preparation of the Raw Material

1) Tapioca flour

It is prepared from white, dry chips obtained from the Tapioca tuber after removing both its outer skin and the inner rind.

Tubers are rich in starch and contain adequate quantities of minerals like calcium, but are very deficient in protein, as the following composition of fresh Tapioca tubers will illustrate:

- Moisture	59,4%	Phosphorus	0,04%
- Protein	0,7%	Iron	0,9 mg
- Fat	0,2%	Vitamin B	0,045 mg
- Mineral matter	1,0%	Nicotinic Acid	0,7 mg
- Carbohydrate (Starch)	38,7%	Riboflavin	0,04 mg
- Calcium	0,05%	Vitamin C	0,24 mg

Great care should be exercised in drying Tapioca chips so as to avoid contemination with dust. The drying has also to be done quickly to avoid fungal growth which introduces undesirable flavour and also otherwise affects the quality of the finished products.

The complete grinding unit comprises a disintegrator such as a hammer mill along with other accessories like a feed device for chips, a magnetic separator, a pneumatic conveying system with cyclone, a sifter and, for collecting dusty air an effective filter section with blower. Storage silos for chips and Tapioca flour so as a suitable arrangement for bagging the flour must be provided. The Swiss Manufacturer disposes of great experience in the field of grinding seeds, cereals and similar and would therefore be pleased in submitting modern propositions together with plans and quotation.

The degree of fineness of the flour is such that about 60% of it has a particle size ranging between 30 - 60 mesh and 40% passes through 60 mesh.

2) Groundnut flour

The damaged and shrivelled kernels of the decorticated groundnuts as obtained from the decorticating machine so as grit and stones etc. are sorted out by means of a shaker fitted with sieves of different mesh size. This separation is based on size grading. The clean kernels are given a light roast in a roaster of the type used for roasting coffee or cocoa beans. The heated kernels are then cooled and the red cuticle removed by mechanical scrubbing in a blanching equipment similar to one used in the manufacture of peanut butter.

The detached cuticle and the germ are separated out by a current of air. It is very necessary to remove the cuticle as, otherwise, it will impair the colour of the flour and also the final product. Great care should be taken to avoid contamination of the kernels with any grit or sand. The decuticled kernels are re-examined for removing any residual defective pieces. The clean kernels are then pressed in a conventional oil-expeller to obtain oil and press-cakes containing the minimum amount of residual oil (max. 5 - 6%). The humidity content is about 8%. The press-cake is ground in a hammer mill and flour with such a degree of fineness as would allow 95 percent of it to pass through 22 mesh, is obtained. The type of flour used contains nearly 50% protein. It is not desirable to store the groundnutflour for long and therefore it should be a normal practice to grind only a week's requirement at a time.

Oil-seed preparation and pressing is also a speciality of the same Swiss Manufacturer. Diagrams, plans and quotation for large and small plants are available on request.

Note: Tapioca chips and groundnut cake have different grinding characteristics and have therefore to be ground separately.

3) Wheat semolina (soji)

The wheat is to be milled in such a degree of fineness that 100 percent pass through 32 mesh. The Swiss Manufacturer is since 100 years builder of roller mills and are prepared to quote for soft and hard wheat, and for any desired capacity.

c) Dry Mixing of Ingredients

A substantial part of the Tapioca Macaroni plant consists in the blending and mixing arrangement.

Bins of adequate size must be provided in order to supply the productions unit (4) with sufficient raw material. The stocking facilities for Tapioca flour, groundnut flour and wheat flour should accommodate at least the necessary quantity for running the plant about 2 days at full capacity.

The raw materials are received in paper or jute bags at about 100 lbs. One to two men pour the flour in a feed hopper with a built-in shaking sieve. A fluidlift (pneumatic transport) with a capacity of 7,5 to/h lifts the raw material up to the top of the 3 silos which are aspirated. The advantages of fluidlift-transports are numberous: Pipes require little space - good

aeration of product - different products can be conveyed one after the other since the pipes empty completely - pneumatic conveying is sanatory, no possibility of infestation.

Each storage bin is fitted with a suitable extraction apparatus which itself feeds an automatically working balance. An electric control panel controls the present number of weighings. For each product such a unit is provided. The blend proportion is therefore easily adjustable.

The simultaneouslyweight mix components come either by gravity or another fluidlift to the mixing unit. For plants with a capacity up to about 15 to/24 h a vertical conical mixer fitted with a central mixing worm can be used. For bigger plants a rapid batch mixer with a horizontal stirring worm is recommended, the total weight per batch is between 700 and 1000 kgs. The necessary mixing time is about 45 to 60 minutes, in a vertical mixer 4 to 10 minutes only, in a rapid batch mixer.

The raw materials are blended in the following proportion: Tapioca flour 60% groundnut flour 15% and wheat 25%. The average moisture content of the ready mix is 10 to 11% of which about 1,1 tons are necessary to produce 1 ton of finished Tapioca Macaroni.

From the mixer unit the homogeneous blend is then pneumatically conveyed to the feed hopper(s) above the press(es). The Tapioca Macaroni blend is not an easily flowing product and therefore it is recommended to arrange the hopper(s) with an accurate stiring device.

Should the condition of the raw material demand it, an efficient arrangement to kill insects and insects' eggs would have to be provided just before or right after the mixer.

d) Production of Tapioca Macaroni

A complete continuous production line consists of:

1) An extrusion press, comprising:
   - a dosing apparatus for raw material mix and boiling water.
   - a continuous working mixer with vacuum device.
   - a press unit, existing of press worm and press cylinder, the latter being of special design for heat treatment of the dough.
   - a presshead to take up a circular die.
   - a cutting apparatus.
   - a fan and various motors, a vacuum pump and an electric control board.

   The raw material blend is mechanically mixed with boiling water in the proportion 100:40. The mixing and kneading time is about 20 to 25 minutes. Before the pressing process the ready dough is evacuated from air at 80 to 90% vacuum. During pressing the dough undergoes a special heat treatment. At about 70°C the starch begins to gelatinize. Due to this procedure the end product becomes hard and excellent cooking and eating qualities so as an improved shelf life.

The main parts of the extrusion press being in contact with the dough are made of stainless steel or rust proof material. The dies are made of bronze or stainless steel and according to their performance the permit to produce short tubes, shells, rice, grains etc.

2) A predryer
of the shaking type, made of a metal framework, panelled with aluminium sheets. Built-in are five oscillating sieves, fans and drive parts with motors.

The cut Tapioca Macaroni fall from the die directly on the top sieve and within 4 to 7 minutes it passes over each sieve. During this time it is intensively ventilated with hot air and gets in this way a superficial drying and an additional heat treatment. The total moisture decrease of the product is 1,5 to 2,5% which is enough to prevent the product from sticking together. It can now easily be handled by an inclined belt conveyor and the following belt dryers.

3) A belt drying unit
which consists principally of two independent sections of different length and with different drying cycles. The first dryer has 7 belts, the second only 5. Each dryer consists of:
- a metal framework (block system) standing on adjustable legs and covered with heat and steam resisting panelling.
- 7 respectively 5 belts made of patented S-shaped aluminium channels.
- an oscillating distributor on top of the dryer.
- a discharge shaker.
- a number of fans, motors, reduction gears and various other drive parts.
- an electric switch board and a temperature control.

The product remains about 40 minutes in the first and passes in approx. 8 hours the second dryer. During drying the product is evenly ventilated with warm air of low psychromatic difference. Temperature and relative humidity of the drying air in the various zones of the dryers must be regulated according a prefixed diagram. The necessary arrangements for this regulation are provided in the dryers. When passing the dryers the goods are several times unloaded which is essential for even drying. The goods leaving the last dryer have a moisture content of about 10 to 11%.

e) Nutritive value, ingredients and shapes of product

The process for the preparation of Tapioca Macaroni products uses as is now known a blend of 60 parts of Tapioca flour, 15 parts of specially processed low fat groundnut flour and 25 parts of wheat semolina so as boiling water.

To make it psychologically more acceptable, the Tapioca Macaroni was until now produced in the shape of rice, small tubes and shells.

The nutritive value of Tapioca is about twice as high as of natural rice. The composition is as follows:

Moisture	11,0%
Protein	10,5%
Fat	1,9%
Ash	1,8%
Fibre	0,7%
Carbohydrates (by difference)	73,8%
Calcium	0,05%
Phosphorus	0,14%
Iron	2,90 mg/100 gr
Thiamine	0,22 mg/100 gr
Nicotinic Acid	3,70 mg/100 gr
Riboflavin	0,07 mg/100 gr

It is an important fact that Tapioca Macaroni products contain large quantities of protein, calcium and vitamins.

Unlike naturally grown grains as rice, wheat etc., Tapioca Macaroni is an extremely clean product. It doesn't contain any foreign matter and is 100% food. It is not required any washing before cooking. The staple food Tapioca Macaroni has the advantage that it cooks within 5 to 8 minutes. Tapioca Macaroni is easily digestible and will benefit particularly growing children.

And never forget that 75% of the raw material used for the preparation of this new and very nutritious staplefood is produced by indigenous agriculture.

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